Chapter 6—
VV&A Common Reporting Formats

6.1 Introduction

The previous chapters provided an overview, principles, processes, and recommended procedures for Verification, Validation, and Accreditation (VV&A). This chapter offers formats for various VV&A reports. The following report formats are provided:

- *VV&A Acceptability Criteria Report*—This report documents the acceptability criteria for deciding if the model or simulation is suitable for the application. (See Table 6-1.)
- *Accreditation Plan*—This plan describes the information needed to approve the use of a model or simulation for a particular application and the planned approach to collect or develop that information. It also establishes the accreditation team and identifies the accreditation resources. (See Table 6-2.)
- *Verification and Validation (V&V) Plan*—This plan describes the V&V requirements, giving rationale, and the recommended V&V approach to satisfy those requirements. (See Table 6-3.)
- *Verification and Validation Report*—This report documents the results of executing the V&V plan. It provides data to the acceptability assessment. (See Table 6-4.)
- *Acceptability Assessment Report*—This report documents (a) the information needed to approve the use of a model or simulation for a particular application, (b) the information that was collected or developed based on the accreditation plan, (c) the comparison of the application M&S requirements to the model's or simulation's capabilities and limitations, (d) the model's or simulation's development and use history, (e) the model's or simulation's operating requirements and cost, (f) implications of the model's or simulation's limitations and constraints for use in this application, and (g) recommendations for changes to the model or simulation to use it for the application or to reduce application risk. (See Table 6-5.) The *Acceptability Assessment Report* is used in formulating the accreditation decision.
- *Accreditation Report*—This report documents the decision to use or not to use a model or simulation for a particular application. It may include limitations on a model's or simulation's use for this particular application. It also may contain direction for modification or for additional verification and validation to reduce overall application risk. The *Accreditation Report* provides the rationale for the decision.

(See Table 6-6.)

The recommended report formats document average to large applications. Smaller applications may have less information in each report, and some of the reports may be combined, e.g., *V&V Plan* and *Accreditation Plan*. Larger applications may generate interim reports at the end of each V&V step. The actual report formats used should satisfy the needs of the application and should capture valuable VV&A effort for use in other applications. Automated aids for generating these reports will be available in the future to support report standardization and to reduce the cost and time of report preparation.

6.2 VV&A Reports in the Application Life Cycle

It is important for the M&S user to recognize the points in the overall application process at which reports, and specifically VV&A reports, are useful. Figure 6-1 gives an overview of the process for an application. The rectangular boxes are functions or steps in the process. The six square, shadowed boxes are reports. The figure outlines the entire application life cycle, but this guide covers only the VV&A portion. The shaded elements in Figure 6-1 are not covered by this manual.

The process starts with the overall application to be addressed. It establishes the basic problem requirements—what problems are to be considered, what answers or solutions are required, what the critical issues are, what the important characteristics and features of the application problems are, and so forth. Based on these application requirements, the approach to meeting them is developed. The application approach can combine several methods to satisfy application needs—field testing, laboratory testing, document research, or M&S. Note that M&S is but one method or tool. A separate approach is taken for non-M&S methods selected to satisfy a subset of the application requirements (subprocess at the top of Figure 6-1), but the results are integrated with the results from an M&S process.

The application requirements to be satisfied by M&S should be clearly identified. These M&S requirements will drive the development of an M&S approach. The M&S approach will direct the types and the combination of M&S that will be used to satisfy specific application requirements. Because application planners typically have multiple M&S candidates to satisfy any particular requirement, a trade-off assessment is made to determine the best M&S suite (or single model) for the application. This assessment may include the V&V status of a model or simulation or its previous accreditation and use. The assessment may suggest use of a particular model as it is (without modification), use of a particular model with some changes, or development of a new model. Once the M&S

approach is selected, the VV&A process for these models or simulations may begin.

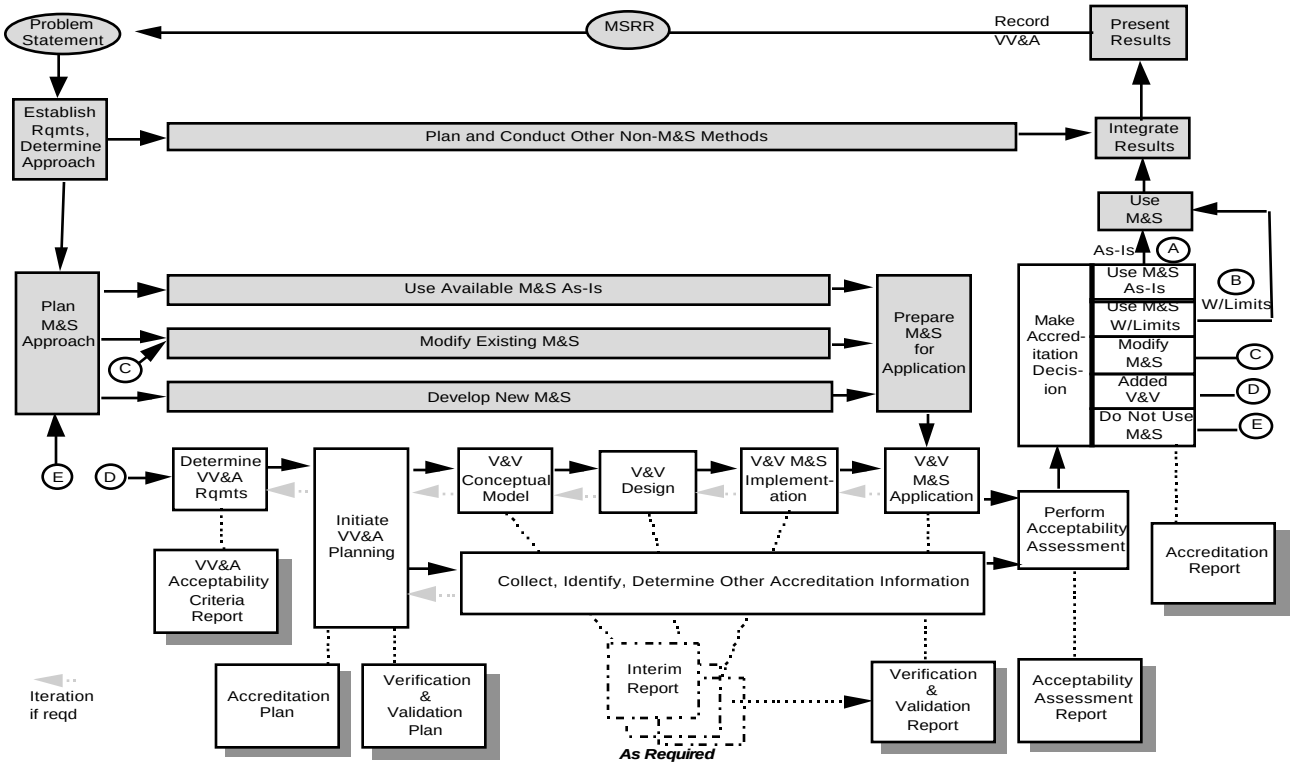

Figure 6-1. VV&A Reports in the M&S Application Life Cycle

The M&S requirements are used to derive VV&A acceptability criteria. These acceptability criteria specify not only the M&S functions and objects that are needed for the application but also the level of fidelity needed for each function and object. These acceptability criteria are documented in the *VV&A Acceptability Criteria Report.* (See Table 6-1.)

The VV&A planning begins with the development of the accreditation plan. It is driven by the application requirements to be met by the M&S approach selected. It uses the acceptability criteria from the *VV&A Acceptability Criteria Report.* The plan also identifies the other types of information (e.g., model or simulation history) that can be used to determine acceptability. This information is documented in the *Accreditation Plan*. (See Table 6-2.)

If an M&S suite is selected for the application, VV&A plans for each model or simulation should be selected. If the VV&A activity is extensive for several models or simulations,

integrating the actions and schedules may be useful to eliminate competition for limited resources and to eliminate redundancy. This integration also can be documented in integrated VV&A reports.

Concurrent with the accreditation plan, the verification and validation plan can be developed and documented in the *V&V Plan*. (See Table 6-3.) The *V&V Plan* prioritizes V&V functions and objects based on the application requirements. It also will consider the V&V that has already been performed on the model or simulation by previous applications. When the *VV&A Plans* are complete and approved by the application manager, the V&V process can begin. The process for collecting non-V&V information needed for accreditation (shown in Table 6-2, sections F and G) may also begin. The V&V process is described in Chapter 3.

When the V&V is completed, it can be documented in the *V&V Report*. (See Table 6-4.) If the V&V activity warrants interim reports at the end of some or all of the V&V steps (e.g., conceptual model validation, design verification), they should be patterned after the applicable sections of the *V&V Report*. Interim reports are input to the final *V&V Report*.

The report format has a section for verification results and another section for validation results. Some of the V&V techniques can be considered for both verification and validation purposes (e.g., sensitivity analysis). Their results can be documented in each section, based on verification or validation criteria, or combined in a single section. With the approval of the application manager, the *V&V Report* can be sent to the Modeling and Simulation Resource Repository (MSRR) for archiving and use by future applications.

The acceptability assessment can be performed using the V&V results and non-V&V information collected. The acceptability assessment considers whether the model's or simulation's capabilities meet or exceed the application requirements. The risk, cost, schedule, and other implications of not meeting the requirements also are evaluated. Based on this assessment, recommendations are developed for review by the accreditation authority. The assessment process, the assessment results, and the recommendations, along with their rationales, are documented in the *Acceptability Assessment Report*. (See Table 6-5.) The *Acceptability Assessment Report*, with the approval of the accreditation authority, is sent to the MSRR.

Based on the *Acceptability Assessment Report* and other information and considerations, the accreditation decision is made. The decision and its rationale are documented in a short *Accreditation Report*. (See Table 6-6.) The decision can have any of the following outcomes:

(A) The model or simulation can be used as is for the application.

(B) The model or simulation can be used with certain limitations in application area. This decision may or may not necessitate a change to the M&S approach.
(C) Modifications to the model or simulation must be made to enhance its capability. This decision will require follow-up V&V.
(D) Additional V&V must be performed before the model or simulation can be accredited for this application.
(E) This model or simulation cannot be used for this application. This decision will necessitate changing the M&S approach, or perhaps even the application approach, and can have a significant impact on cost and schedule.

Table 6-1. *VV&A Acceptability Criteria Report* Format

A. Application Description—description of overall program for which accreditation will be accomplished

1. Program name
2. Short description
3. Program sponsor or responsible agency
4. Major program issues and objectives
5. Program importance and major risks
6. Program approach and methodology summary
7. Program schedule summary

B. Application M&S Requirements and Acceptability Criteria

1. Major M&S requirement areas (overview)
2. Requirement Area 1—Section B.2 is repeated for Requirement Area 2 through Requirement Area *N*.
   a. Major requirement area description
   b. Priority and importance of area to application accomplishment
   c. List of objects and functions with acceptability criteria—may include priority and importance of each object and function

ATTACHMENTS:

M&S Requirements document (if any)
Program Requirements document (if any)

Table 6-2. *Accreditation Plan* Format

A. Application Description and M&S Approach

1. Description of overall program for which accreditation will be accomplished
    a. Program name
    b. Short description
    c. Program sponsor or responsible agency
    d. Major program issues and objectives
    e. Program importance and major risks
    f. Program approach and methodology summary
    g. Program schedule summary
2. Program M&S methodology
    a. Model or simulation requirements (general)
    b. Model or simulation selected (or candidates)
    c. Proposed model's or simulation's use in decision process (integration with other methods and data)
3. Accreditation officials
    a. Accreditation authority
    b. Accreditation agent and team

B. Model Description

1. Model description
    a. Title
    b. Version
    c. Scope and overview
2. Model sponsor
3. Model configuration manager
4. Proposed use in decision process (integration with other methods and data)
5. Key objects and functions represented (see Section D.2 for complete list)
6. Operating environment (intended host hardware, software)
7. Key sources of data

C. Application M&S Requirements and Acceptability Criteria

1. Major M&S requirement areas (overview)
2. Requirement Area 1—Section C.2 is repeated for Requirement Area 2 through Requirement Area *N*.
    a. Major requirement area description
    b. Priority and importance of area to application accomplishment
    c. List of objects and functions with acceptability criteria—may include priority and importance of each object and function

D. Model Capability

1. Major model capability areas (overview)
2. List of model objects and functions represented
3. Comparison of model capability areas to application requirements areas—Will model be used in each application requirements area?
4. Major model limitations for each object and function

Table 6-2. *Accreditation Plan* Format (continued)

E. V&V Plan Summary

1. Verification Plan Summary
    a. Verification approach overview
    b. List of verification activities for each required area—For each model section in verification plan, provide the verification method and the verification agent.
2. Validation Plan Summary
    a. Validation approach overview
    b. List of validation activities for each required area—For each model section in validation plan, provide the validation method and the validation agent.
3. Data Verification, Validation, and Certification (VV&C) Plan Summary
    a. VV&C approach overview
    b. List of VV&C activities for each required area—For each data base section in VV&C plan, provide the VV&C method and the VV&C agent.
4. Schedule integrating all verification, validation, and data VV&C activities

F. Other Accreditation Information Requirements

1. Model or simulation development and use history
    a. Model development
        (1) Initial model developers and development sponsor
        (2) Reason for initial development (e.g., project, study)
        (3) Model development methods applied
        (4) Major model modifiers and modification sponsors
        (5) Reason for modifications (e.g., project, study)
        (6) Model modification methods applied
    b. Model or simulation use—For each major application, the following information is desired:
        (1) Major application and application sponsor
        (2) Time frame of application
        (3) Critique of model or simulation use in application, e.g., limitations discovered, operational problems, unexpected delays or costs, data base problems, overall success of model or simulation application
2. Implications of operational environment requirements
    a. Necessary hardware configuration needed to run the simulation including implications of storage and storage devices, processor speed, telecommunications links
    b. Necessary software environment including operating system, language processors, support software, display software, data base systems
    c. Necessary personnel for operation including number and expertise level for modeling and simulation operation and analysis
    d. Necessary security requirements
3. Description of configuration management system and process being applied to this model or simulation including listing of Configuration Control Board members/chair
4. Model or simulation documentation available including breadth (types of documentation), depth (detail of documentation), accuracy, and currency
5. Other known capabilities/limitations of the model or simulation or its data base

Table 6-2. *Accreditation Plan* Format (continued)

G. Plan to Collect Other Accreditation Information

1. Sources of information about the model or simulation
    a. Repositories
    b. Configuration manager
    c. Developer
    d. Users
    e. Project and study reports, including other VV&A reports
    f. Documentation
2. Schedule and resources for collecting the information—considerations include security, volume of documentation/information, organizational sensitivities

H. Accreditation Plan Integrated Schedule/Resources—an integrated schedule with resources planned for all V&V and accreditation information development and collection

ATTACHMENTS:

M&S Requirements document (if any)
M&S Selection Report (if any)

Table 6-3. *Verification and Validation Plan* Format

A. Application Description and M&S Approach

1. Description of overall program for which V&V is being accomplished
    a. Program name
    b. Short description
    c. Program sponsor or responsible agency
    d. Major program issues and objectives
    e. Program importance and major risks
    f. Program approach and methodology summary
    g. Program schedule summary
2. Program M&S methodology
    a. Model or simulation requirements (general)
    b. Model or simulation selected (or candidates)
    c. Proposed model's or simulation's use in decision process (integration with other methods and data)

B. Model Description

1. Model description
    a. Title
    b. Version
    c. Scope and overview
2. Model sponsor
3. Model configuration manager
4. Proposed use in decision process (integration with other methods/data)
5. Key objects and functions represented (see Section D.2 for complete list)
6. Operating environment (intended host hardware, software)
7. Key sources of data

C. Application M&S Requirements and Acceptability Criteria

1. Major M&S requirement areas (overview)
2. Requirement Area 1—Section C.2 is repeated for Requirement Area 2 through Requirement Area *N*.
    a. Major requirement area description
    b. List of objects and functions with acceptability criteria

D. Model Capability

1. Major model capability areas (overview)
2. List of model objects and functions represented
3. Comparison of model capability areas to application requirements areas—Will model be used in each application requirements area?
4. Major model limitations object and function

Table 6-3. *Verification and Validation Plan* Format (continued)

E. Model V&V Status

1. List of model objects and functions with verification status and validation status given
    a. Verification status is listed separately from validation status
    b. Each object and function status includes the following:
        (1) What specific effort provided V or V
        (2) When it was accomplished
        (3) What model version it was accomplished on
        (4) Pointer to detailed V&V report containing this specific information

F. Model V&V Requirements

1. List of model objects and functions with verification requirements and validation requirements
    a. Correlation to list of activities in Sections F.2 and F.3
    b. Importance or risk of not performing V or V
2. List of individual verification activities to be conducted
3. List of individual validation activities to be conducted

G. Verification Plan

1. Overview of all verification activities
2. Verification Activity 1—Section G.2 is repeated for Verification Activity 2 through Verification Activity *N.*
    a. Verification activity approach, which includes the following:
        (1) Model sections to be verified
        (2) Verification methods to be employed
        (3) Information and data sources
    b. Verification agents, key players
    c. Verification activity schedule (with milestones)
    d. Resources required
3. Integrated schedule and resources required layout for Verification Activity 1—Section G.3 is repeated for Verification Activity 2 through Verification Activity *N*.

H. Validation Plan

1. Overview of all validation activities
2. Validation Activity 1—Section H.2 is repeated for Validation Activity 2 through Validation Activity *N.*
    a. Validation activity approach, which includes the following:
        (1) Model sections to be validated
        (2) Validation methods to be employed
        (3) Information and data sources
    b. Validation agents, key players
    c. Validation activity schedule (with milestones)
    d. Resources required
3. Integrated schedule and resources required layout for Validation Activity 1—Section H.3 is repeated for Validation Activity 2 through Validation Activity *N.*

Table 6-3. *Verification and Validation Plan* Format (continued)

I. Data Verification, Validation and Certification (VV&C) Plan *(if required or separate from other V&V plans)*

1. Overview of all data VV&C activities
2. Data VV&C Activity 1—Section I.2 is repeated for VV&C Activity 2 through VV&C Activity *N*.
   a. Data VV&C activity approach, which includes the following:
      (1) Model data base sections needing VV&C
      (2) Data VV&C methods to be employed
      (3) Information and data sources
   b. Data VV&C agents, key players
   c. Data VV&C activity schedule (with milestones)
   d. Resources required
3. Integrated schedule and resources required layout for VV&C Activity 1—Section I.3 is repeated for VV&C Activity 2 through VV&C Activity *N*.

J. Integrated Verification and Validation

1. Schedule integrating all verification, validation, and data VV&C activities
2. Summary of resources for all verification, validation, and data VV&C activities

ATTACHMENTS:

M&S Requirements document (if any)
M&S Selection Report (if any)

Table 6-4. *Verification and Validation Report* Format

A. Executive Summary
1. Summary of V&V Plan
2. Summary of all sections of this report

B. Differences from V&V Plan
1. Verification differences—list of differences in the executed verification activity from the planned verification
2. Validation differences—list of differences in the executed validation activity from the planned validation
3. Verification, Validation, and Certification (VV&C) differences—list of differences in the executed VV&C activity from the planned VV&C

C. V&V Results
1. Verification results—Section C.1 is repeated for Verification Area 2 through Verification Area *N*.
   a. Verification Area 1 description
   b. Model section(s) verified
   c. Verification approach taken
   d. Schedule of activities, resources used
   e. Verification agent
   f. Verification results
2. Validation results—Section C.2 is repeated for Validation Area 2 through Validation Area *N*.
   a. Validation Area 1 description
   b. Model section(s) validated
   c. Validation approach taken
   d. Schedule of activities, resources used
   e. Validation agent
   f. Validation results
3. Data VV&C results—Section C.3 is repeated for VV&C Area 2 through VV&C Area *N*.
   a. Data VV&C Area 1 description
   b. Model section(s) needing data VV&C
   c. VV&C approach taken
   d. Schedule of activities, resources used
   e. Data VV&C agent
   f. Data VV&C results

D. V&V Summary—contains summary of V&V activities performed, the integrated schedule of performance, and a summary of resources used

ATTACHMENT:
Verification and Validation Plan

Table 6-5. *Acceptability Assessment Report* Format

A. Summary
1. Application description
2. M&S approach
3. Model description

B. Application M&S Requirements and Acceptability Criteria
1. Major M&S requirement areas (overview)
2. Major Requirement Area 1 description with acceptability criteria—Section B.2 is repeated for Requirement Area 2 through Requirement Area *N*.

C. Model Capability
1. Major model capability areas (overview)
2. List of model objects and functions represented
3. Comparison of model capability areas to application requirements areas—Will model be used in each application requirements area?
4. Major model limitations of each object and function

D. V&V Report Summary
1. Verification results summary
    a. Verification approach overview
    b. List of verification activities accomplished for each required area—For each verified model section, provide the verification method, the verification agent, and verification result.
2. Validation report summary
    a. Validation approach overview
    b. List of validation activities accomplished for each required area—For each validated model section, provide the validation method, the validation agent, application requirement, and model capability and accuracy.
3. Data Verification, Validation, and Certification (VV&C) report summary
    a. VV&C approach overview
    b. List of VV&C activities accomplished for each required area—For each data base section for which VV&C is needed, provide the VV&C method, the VV&C agent, and the VV&C result.

E. Comparison Analysis of Requirements versus Capabilities—For each major model section that had an application requirement, provide the following information:
1. Major model section name and short description
2. Application requirements for this section
3. Model capability/accuracy results of V&V activity
4. Comparison of requirements to model capability—includes analysis of differences and implications for application in terms of risk, cost, schedule

F. Comparison Analysis Summary
1. Prioritized list of model sections that do not meet application requirements
    a. Prioritized in terms of risk to the application
    b. Includes recommendations for reducing risk with cost and schedule implications of risk-reduction action

Table 6-5. *Acceptability Assessment Report* Format (continued)

2. List of model sections that meet or exceed application requirements—includes any implications for application for exceeding application requirements

G. Other Accreditation Information—Include the source of all data and information for all items.

1. Model or simulation development and use history
   a. Model development
      (1) Initial model developers and development sponsor
      (2) Reason for initial development (e.g., project, study)
      (3) Model development methods applied
      (4) Major model modifiers and modification sponsors
      (5) Reason for modifications (e.g., project, study)
      (6) Model modification methods applied
   b. Model or simulation use—For each major application, the following information is desired:
      (1) Major application and application sponsor
      (2) Time frame of application
      (3) Critique of model or simulation use in application, e.g., limitations discovered, operational problems, unexpected delays or costs, data base problems, overall success of model or simulation application
2. Implications of operational environment requirements
   a. Necessary hardware configuration needed to run the simulation including implications of storage and storage devices, processor speed, telecommunications links
   b. Necessary software environment including operating system, language processors, support software, display software, data base systems
   c. Necessary personnel for operation including number and expertise level for model or simulation operation and analysis
   d. Necessary security requirements
3. Description of configuration management system and process being applied to this model or simulation including listing of configuration control board members and chair
4. Model or simulation documentation available including breadth (types of documentation), depth (detail of documentation), accuracy, and currency
5. Other known capabilities/limitations of the model or simulation and its data base

H. Recommendations

1. Recommendation summary—statement of model or simulation useability for application. It can be one of the following alternatives. It may also be a combination of b and c.
   a. The model or simulation can be used as described in M&S Requirements Plan for this application.
   b. The model or simulation can be used as described in M&S Requirements Plan for this application with limitations.
   c. The model or simulation can be used as described in M&S Requirements Plan for this application with recommended modifications.
   d. The model or simulation requires additional V&V to be considered suitable for accreditation.
   e. The model or simulation should not be used for this application as described in M&S Requirements Plan.

Table 6-5. *Acceptability Assessment Report* Format (continued)

2. ***If alternative b is recommended.*** Limitations of model or simulation use for this application—provides the limitations in use relative to the M&S Requirements Plan for this application. It may include changes in the requirements plan, or use of a different tool to eliminate the limitation.
3. ***If alternative c is recommended.*** Changes that should be made if the model or simulation is to be used for the application—The following is a prioritized list. For each recommendation, include the following information:
   a. Modification enhancement—includes model and model data base sections affected
   b. Risk involved in not making modification
   c. Estimate of cost and schedule to implement modification
4. ***If alternative d is recommended.*** Changes that should be made if the model or simulation is to be used for the application—The following is a prioritized list. For each recommendation, include the following information:
   a. Additional V&V description—includes model and model data base sections affected
   b. Risk involved in not doing additional V&V
   c. Estimate of cost and schedule to perform additional V&V
5. ***If alternative e is recommended.*** Recommendations to satisfy analysis void if selected model or simulation not used—This section may include a different model or simulation, other analysis tools, or other sources of data and information that may be used to satisfy the application requirements. It may also suggest changes in application requirements to make accomplishment more feasible.

Table 6-6. *Accreditation Report* Format

A. Summary of Application and M&S Approach

1. Description of overall program for which accreditation applies
2. Program M&S methodology
    a. M&S requirements for selected model or simulation
    b. Model or simulation selected
    c. Model or simulation use in decision process (integration with other methods/data)
    d. Model or simulation description (title, version, overview)

B. Accreditation

1. Accreditation summary—decision for model or simulation useability for this application. It can be one of the following alternatives. It may also be a combination of b and c.
    a. The model or simulation will be used as described in M&S Requirements Plan for this application.
    b. The model or simulation will be used as described in M&S Requirements Plan for this application with limitations.
    c. The model or simulation will be used as described in M&S Requirements Plan for this application with modifications.
    d. The model or simulation requires additional V&V to be considered suitable for accreditation.
    e. The model or simulation will not be used for this application as described in M&S Requirements Plan.
2. ***If alternative b is selected.*** Limitations of model or simulation use for this application—the following is a list of limitations. For each limitation, include this information:
    a. Limitation description
    b. Rationale or risk involved in not imposing limitation
3. ***If alternative c or d is selected.*** Changes that will be made for the model to be used for this application—The following is the list of modifications to be made or additional V&V to be done. For each modification, include the following information:
    a. Modification enhancement or additional V&V description
    b. Rationale or risk involved in not making modification or additional V&V
4. ***If alternative e is selected.*** Follow-on accreditation actions—can include requirements for new annexes to be added to the V&V Plan and/or Accreditation Plan for the required modifications or additional V&V and may include the requirement for a supplemental accreditation decision and report

ATTACHMENT:

Acceptability Assessment Report